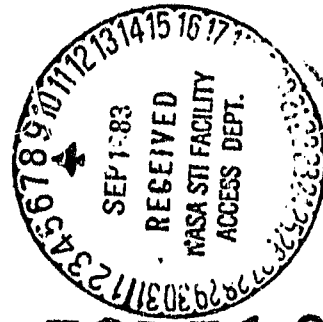


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SPT

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Progress Report 3

Landsat 4 Scientific Characterization

Contract #S-10772-C

Information Content of Data from the Landsat-4 Thematic
Mapper (TM) and Multispectral Scanner (MSS)

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Original photography may be purchased
from ERDC Data Center
Sioux Falls, SD 57198



(E83-10396) INFORMATION CONTENT OF DATA
FROM THE LANDSAT-4 THEMATIC MAPPER (TM) AND
MULTISPECTRAL SCANNER (MSS) Progress Report
(Agricultural Research Center) 7 p
HC A02/MF A01

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INFORMATION CONTENT OF DATA FROM THE LANDSAT 4 THEMATIC
MAPPER AND MULTISPECTRAL SCANNER

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Beltsville, Maryland 20705

The purpose of the investigation is to quantify the increased information content of Thematic Mapper (TM) data as compared to that from the Landsat 4 Multispectral Scanner (MSS). A description of the reasons for making this comparison and of the methodology is contained in the manuscript, "A Preliminary Comparison of the Information Content of Data from the Landsat 4 Thematic Mapper and Multispectral Scanner." This was submitted for inclusion in the proceedings of the February 22-24 meeting at Goddard.

Accomplishments:

1) Data needed for completing the investigation have all been received. During this quarter the bulk of the requested computer compatible tapes were reformatted to more useable (BIL) form at the Washington Computer Center.

This was a formidable job. Scenes to be used in the analysis are:

- | | | | |
|-----------------------|-------------------|-------------|-------------------|
| a) Northeast Arkansas | 22 August 1982 | 40037-16031 | TM-P, MSS-A |
| b) Iowa | 26 September 1982 | 40072-16325 | TM-P, MSS-P |
| c) Western Kentucky | 18 October 1982 | 40094-15574 | TM-P, MSS-P |
| d) Washington, D.C. | 2 November 1982 | 40109-15140 | TM-P, TM-A, MSS-P |
| e) Salton Sea, CA | 12 December 1982 | 40149-17444 | TM-P, MSS-P |

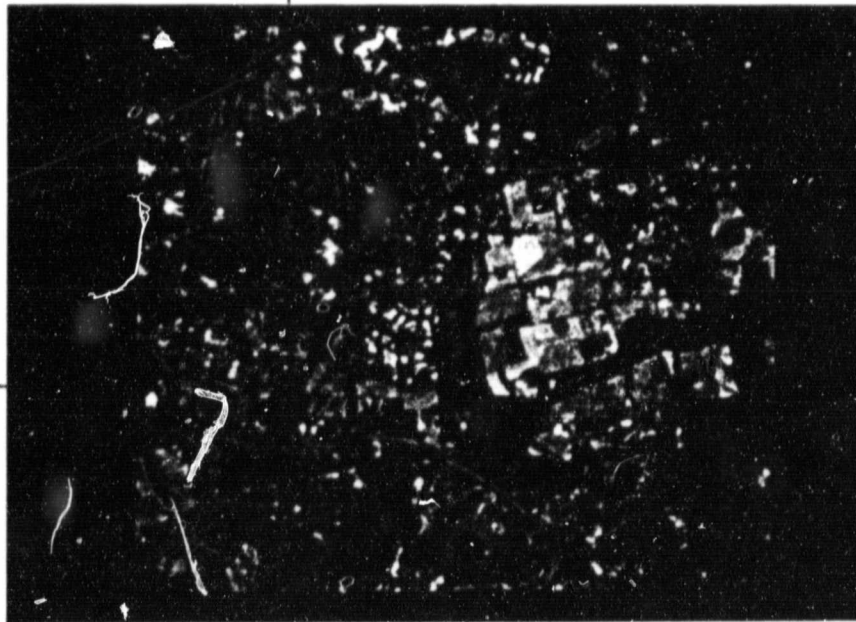
plus two night images - Band L (logical) 7

- | | | | |
|--------------------|-----------------|-------------|------|
| f) Buffalo, NY | 22 August 1982 | 40037-02243 | TM-P |
| g) Adirondacks, NY | 20 October 1982 | 40096-20272 | TM-P |

Errors, one by this investigator and one in a catalog listing, resulted in acquisition of TM-P scenes for South Dakota and Indiana. These scenes will not be used.

The selection of scenes is less than optimum, as all images were acquired somewhat later than the peak of the agricultural growing season (May to mid August). However, it is quite satisfactory, given the rather limited amount of data which has been acquired simultaneously by TM and MSS.

2) Small subscenes of 256 x 256 pixels have been read from WCC to Beltsville over a 1200 band phone line and the image data displayed on a low cost (>\$20,000) image display system. The following photo from the screen shows that the display capability is quite acceptable.



Beltsville Agricultural Research Center
TM acquired 2 November 1982. The author's building
is indicated by marks at the border.

The imagery was used to establish matching pixels (line and sample number) for the TM and MSS for the 5 daytime pairs. The procedure took longer than necessary because the student technician did not appreciate the significance of the fact that the TM and MSS prints and transparencies are at slightly different scales. The matching process is now complete.

3) The software for carrying out the analysis of the image data is now complete. Completion of this phase has been delayed by other commitments of the principal investigator.

4) The two night IR images have been examined and compared with HCMM data. The two data types present an interesting contrast because of differing spatial resolution (120 m versus 600 m), time of acquisition (9:15 p.m. versus 2:30 a.m.) and noise ($NE\Delta T$ 0.4 K for HCMM). The following comments apply:

a) The night imagery from the TM is "flat," i.e., has low contrast. Examination shows that this does not result from degradation by the photographic process, as the detector to detector banding is already marginally visible in the imagery. Digital enhancement was used to verify this conclusion.

b) The HCMM data has considerably higher contrast due to the later time of acquisition, which permits greater surface temperature contrast to develop as a result of radiative cooling, and also due to the high quality digital enhancement which was applied to all HCMM image products.

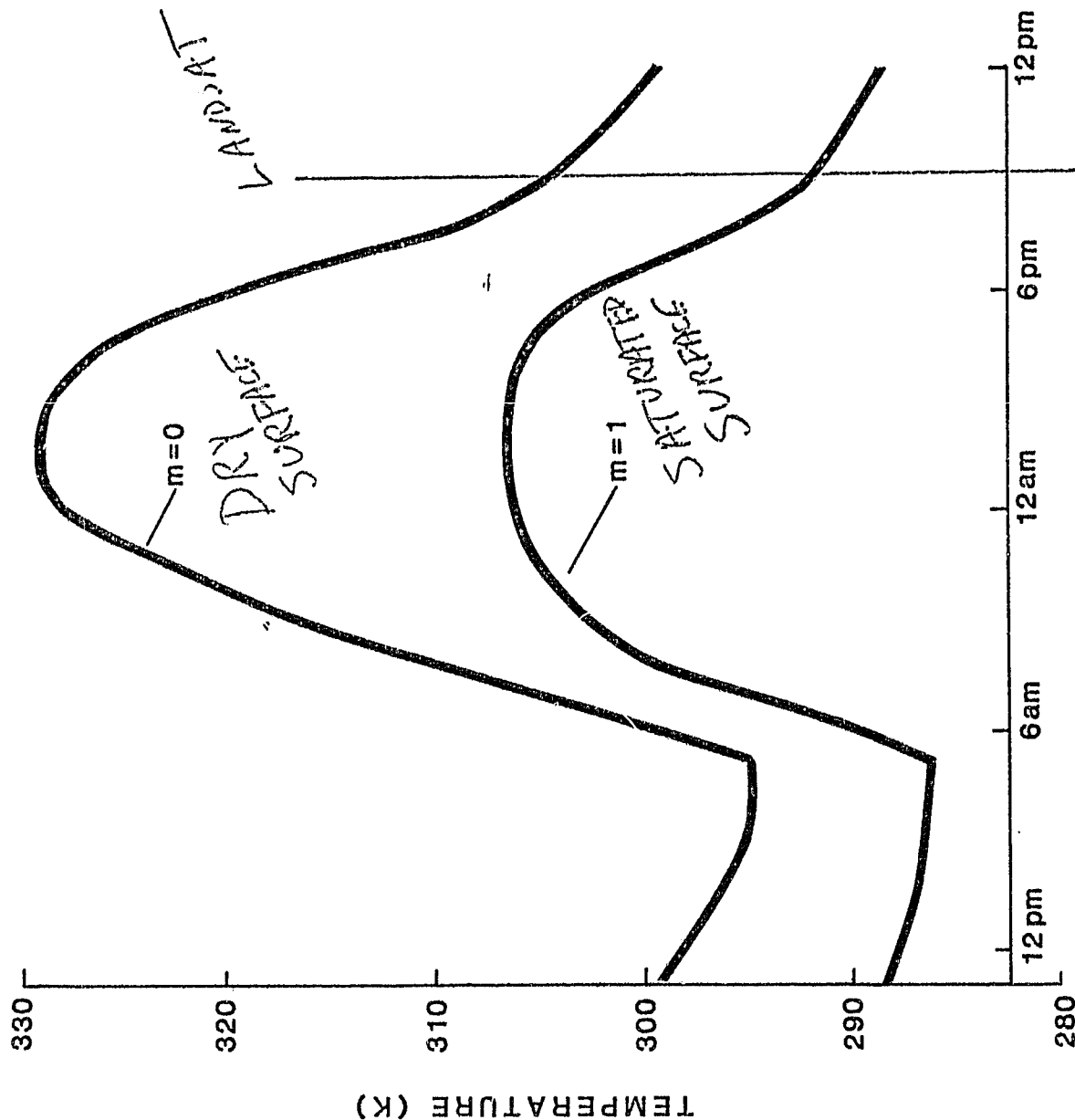
c) Although the TM data represents a miniscule sample of 2, the data do not show some features associated with topography which are quite evident in HCMM imagery. An effort will be made to document this in the final report to NASA.

d) Although the tradeoff of spatial resolution versus time of data acquisition is not well defined, it seems that the nighttime passes of Landsat are not susceptible to theoretical analysis because of the inability to distinguish evaporative cooling from the effect of diurnal heat capacity. The attached figures show that this confusion of effects is substantial in the night acquired data. This ambiguity should be much smaller in the day L7 data from Landsat, but a quantitative analysis is beyond the scope of this investigation.

Reference: Price, J. C., 1982, Estimation of Regional Scale Evapotranspiration through Analysis of Satellite Thermal-Infrared Data, IEEE Trans. of Geoscience and Remote Sensing, Vol. GE-20, pp. 286-292.

Problems and Recommendations: None, except that the documentation is too bulky and very disorganized. The GE documentation for the new tape format is the first to have page numbers in the table of contents.

Funds expended: \$2,000 this quarter.

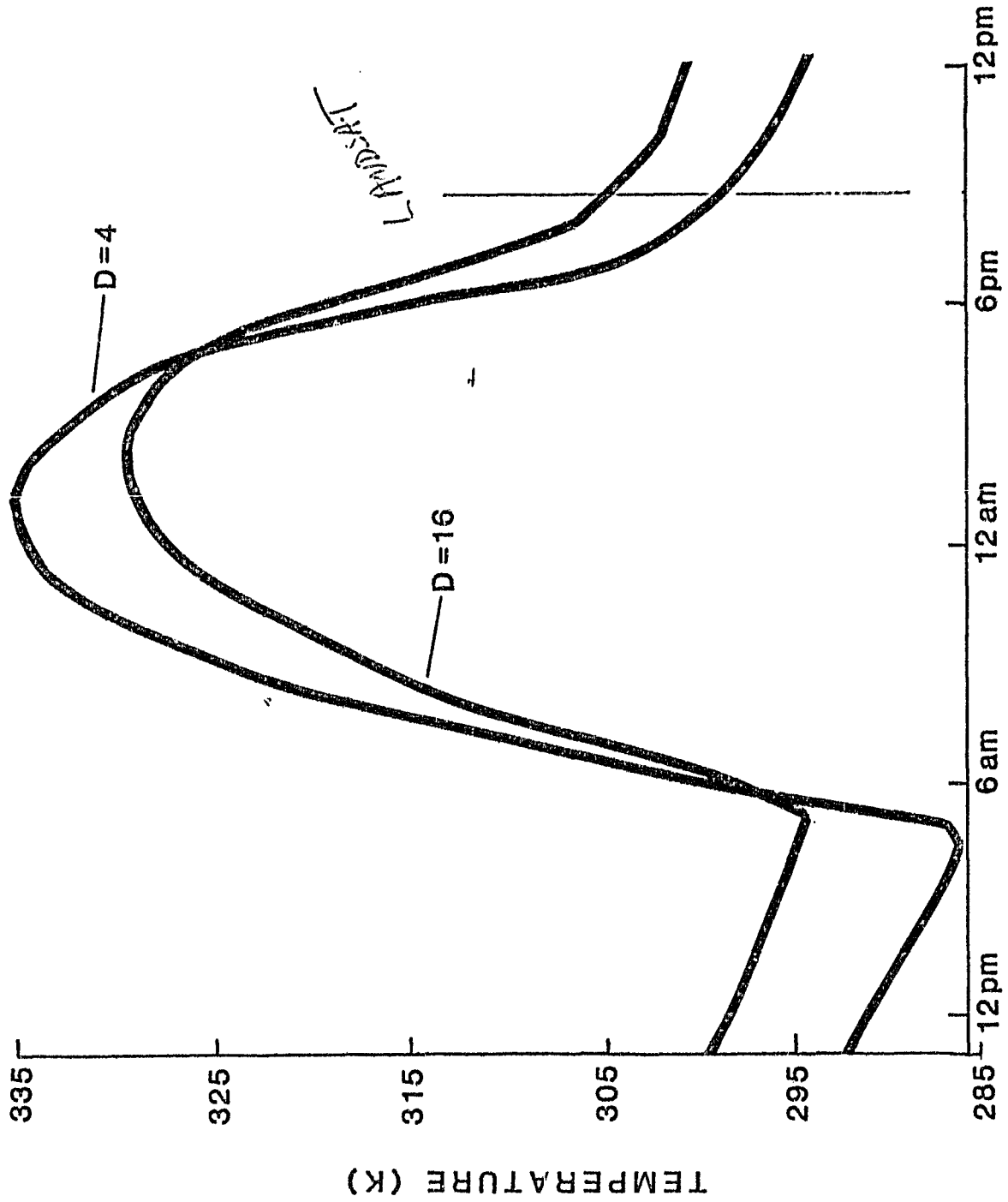


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COMPUTED SURFACE TEMPERATURES FOR 2
VALUES OF SURFACE RELATIVE HUMIDITY

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COMPUTED SURFACE TEMPERATURES FOR 2
VALUES OF DIURNAL HEAT CAPACITY